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FORM PTO-1390 (Modified) (REV 5-93)		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		ATTORNEY'S DOCKET NUMBER 037267-0142	
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371					
				U.S. APPLICATION NO. (If known, see 37 CFR 1.51) Unassigned 107031344	
INTERNATIONAL APPLICATION NO. PCT/JP00/04901		INTERNATIONAL FILING DATE 21 July 2000		PRIORITY DATE CLAIMED 22 July 1999	
TITLE OF INVENTION CELLULAR SYSTEM AND METHOD OF MAKING COMMUNICATION IN MULTI-CODE CDMA					
APPLICANT(S) FOR DO/EO/US Yoshiki WAKIZAKA					
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:					
1. <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.					
2. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.					
3. <input type="checkbox"/> This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).					
4. <input checked="" type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19 th month from the earliest claimed priority date.					
5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2)) <input type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau). <input checked="" type="checkbox"/> has been transmitted by the International Bureau. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US)					
6. <input checked="" type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371(c)(2)).					
7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)) <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau). <input type="checkbox"/> have been transmitted by the International Bureau. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired. <input checked="" type="checkbox"/> have not been made and will not be made.					
8. <input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).					
9. <input type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).					
10. <input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).					
11. <input type="checkbox"/> Applicant claims small entity status under 37 CFR 1.27.					
Items 12. to 17. below concern other document(s) or information included:					
12. <input checked="" type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98.					
13. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.					
14. <input type="checkbox"/> A FIRST preliminary amendment. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment.					
15. <input checked="" type="checkbox"/> A substitute specification.					
16. <input type="checkbox"/> A change of power of attorney and/or address letter.					
17. <input checked="" type="checkbox"/> Other items or information: Application Data Sheet, Copy of Amendments under PCT Article 34 and translation thereof					

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U.S. APPLICATION NO. (If known, see 37 CFR 1.50) Unassigned		10/031344		INTERNATIONAL APPLICATION NO PCT/JP00/04901		ATTORNEY'S DOCKET NUMBER 037267-0142	
18. <input checked="" type="checkbox"/> The following fees are submitted:						CALCULATIONS	
Basic National Fee (37 CFR 1.492(a)(1)-(5): Search Report has been prepared by the EPO or JPO.....\$890.00							
International preliminary examination fee paid to USPTO (37 CFR 1.482).....\$710.00							
No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)).....\$740.00							
Neither international preliminary examination fee (37 CFR 1.482) nor International search fee (37 CFR 1.445(a)(2)) paid to USPTO.....\$1,040.00							
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4).....\$100.00							
ENTER APPROPRIATE BASIC FEE AMOUNT =						\$890.00	
Surcharge of \$130.00 for furnishing the oath or declaration later than 20 Months from the earliest claimed priority date (37 CFR 1.492(e))						\$0.00	
Claims	Number Filed		Included in Basic Fee		Extra Claims		Rate
Total Claims	16	-	20	=	0	x	\$18.00
Independent Claims	4	-	3	=	1	x	\$84.00
Multiple dependent claim(s) (if applicable)							\$280.00
TOTAL OF ABOVE CALCULATIONS =							\$1254.00
Reduction by 1/2 for filing by small entity, if applicable.							\$0.00
SUBTOTAL =							\$1254.00
Processing fee of \$130.00 for furnishing English translation later the 20 months from the earliest claimed priority date (37 CFR 1.492(f). +							
TOTAL NATIONAL FEE =							\$1254.00
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property +							
TOTAL FEES ENCLOSED =							\$1254.00
						Amount to be: refunded	\$
						charged	\$
<p>a. <input checked="" type="checkbox"/> A check in the amount of \$1254.00 to cover the above fees is enclosed.</p> <p>b. <input type="checkbox"/> Please charge my Deposit Account No. <u>19-0741</u> in the amount of \$0.00 to the above fees. A duplicate copy of this sheet is enclosed.</p> <p>c. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. <u>19-0741</u>. A duplicate copy of this sheet is enclosed.</p>							
<p>NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.</p>							
<p>SEND ALL CORRESPONDENCE TO:</p> <p>Foley & Lardner Customer Number: 22428</p>  <p>22428</p> <p>PATENT TRADEMARK OFFICE</p>				<p></p> <p>SIGNATURE</p> <p>NAME <u>Ankur D Shah 41514</u> DAVID A. BLUMENTHAL</p> <p>REGISTRATION NUMBER 26,257</p>			

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SPECIFICATION

CELLULAR SYSTEM AND METHOD OF MAKING COMMUNICATION IN MULTI-CODE CDMA

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FIELD OF THE INVENTION

The invention relates to a cellular system and a method of making communication in multi-code CDMA both of which are capable of effectively using channels of a base station or base stations in multi-code CDMA (Code Division
10 Multiple Access) communication.

BACKGROUND OF THE INVENTION

There have been suggested many mobile communication apparatuses or systems operating in CDMA. For instance, Japanese Unexamined Patent
15 Publication No. 8-274687 has suggested a CDMA wireless communication system, Japanese Unexamined Patent Publication No. 9-200115 has suggested a method of controlling directivity of an antenna in a radio-station in CDMA wireless communication system, Japanese Unexamined Patent Publication No. 10-190626 has suggested a CDMA receiver, Japanese Unexamined Patent Publication No.
20 10-308972 has suggested a CDMA cellular system, and Japanese Unexamined Patent Publication No. 11-74820 has suggested a CDMA signal receiver.

When a mobile communication system operating in CDMA transmits data at a rate greater than a data transmission rate per one channel (one diffusion sign), it generally transmits data in multi-code transmission where it
25 assigns a plurality of channels, that is, a plurality of diffusion signs to a user, and transmits data through a plurality of channels.

However, a conventional mobile communication system operating in multi-code CDMA is accompanied with the following two problems.

The first problem is that when high-rate communication is to be made

in multi-code, if it is not possible to secure channels of a base station for all codes, the system cannot provide services to a mobile station.

The second problem is that when high-rate communication is to be made in multi-code, it would be necessary to increase the number of channels in a base station in order to provide a high connection ratio to a mobile station, resulting in that a base station could not be constructed in a small size.

In order to solve the above-mentioned problems in the conventional mobile communication system operating in multi-code CDMA, it is an object of the present invention to provide a cellular system operating in multi-code CDMA and a method of making communication in multi-code CDMA both of which are capable of effectively using channels of a base station, when high-rate communication is to be made in multi-code CDMA.

SUMMARY OF THE INVENTION

To accomplish the above-mentioned object, the present invention provides a cellular system including at least two base stations, a mobile station making communication with the base stations in multi-code CDMA, and an host station controlling communication made between the base stations and the mobile station, characterized in that when one of the base stations becomes saturated, the mobile station makes communication in multi-code CDMA through a channel of other base station(s).

In accordance with the above-mentioned cellular system, while a mobile station is making communication with a certain base station in multi-code CDMA, even if channels of the certain base station are saturated, the mobile station can continue making communication in multi-code CDMA through channels of another base station, for instance, a base station located adjacent to the certain base station.

If channels of a base station with which a mobile station is making communication in multi-code CDMA are saturated, it was impossible in the

conventional cellular system to continue making communication in multi-code CDMA in a mobile station and a base station. In contrast, even in the same case, the present invention makes it possible to continue making communication in multi-code CDMA between a mobile station and a base station through channels of other base station(s).

It is preferable that the mobile station, when channels of a base station with which the mobile station makes communication are saturated, stops a part of the communication, and makes the thus stopped part of the communication with other base station(s).

In the cellular system in accordance with the present invention, if channels of a base station are saturated while a mobile station is making multi-code CDMA communication with the base station, communication between the mobile station and the base station is partially stopped. A part of the stopped communication is made through the mobile station and other base station(s). Thus, the mobile station can continue making communication in multi-code CDMA with the base station through channels of other base station(s), for instance, a base station located adjacent to the base station.

If channels of a base station with which a mobile station is making communication in multi-code CDMA are saturated, it was impossible in the conventional cellular system to continue making communication in multi-code CDMA in a mobile station and a base station. In contrast, even in the same case, the present invention makes it possible to continue making communication in multi-code CDMA between a mobile station and a base station through channels of other base station(s).

It is preferable that the one of the base station(s) and the other base station(s) have an adaptive array antenna.

Since an adaptive array antenna has high directivity, even if a mobile station is located in an area where channels of the above-mentioned other base station(s) generally cannot be assigned to a mobile station, it would be possible to

assign channels to the mobile station.

The present invention provides a cellular system including at least two base stations, a mobile station making communication with the base stations in multi-code CDMA, and an host station controlling communication made between
5 the base stations and the mobile station, characterized in that one of the base stations, on receipt of a request of starting communication in n codes (n is an integer equal to or greater than 2) from the mobile station, checks whether channels are short, and transmits the result of checking to the host station, the host station receives the result from the one of the base stations, and, if channels
10 for n codes can be secured, instructs the one of the base stations to start making communication, whereas if channels for m codes (m is an integer smaller than n ($m < n$)) can be secured, instructs the one of the base stations to start making communication in m codes and further instructs other base station(s) to start making communication in $(n - m)$ codes, and the mobile station makes
15 communication with the one of the base stations in m codes, and further makes communication with the other base station(s) in $(n - m)$ codes.

In the cellular system in accordance with the present invention, a base station, on receipt of a request to start making communication in n codes, judges whether it is possible to secure channels covering n codes. If possible, the base
20 station makes communication in n codes with a mobile station. If not possible, the base station counts the number of codes the base station can secure. For instance, if the base station can secure m codes, the mobile station makes communication in m codes with the base station, and further makes communication in $(n - m)$ codes with other base station(s). That is, the mobile
25 station makes communication with two base stations in totally n codes.

In the cellular system in accordance with the present invention, even if channels of a base station are saturated while a mobile station is making multi-code CDMA communication with the base station, the mobile station can continue making communication in multi-code CDMA with the base station through

channels of other base station(s), for instance, a base station located adjacent to the base station.

If channels of a base station with which a mobile station is making communication in multi-code CDMA are saturated, it was impossible in the conventional cellular system to continue making communication in multi-code CDMA in a mobile station and a base station. In contrast, even in the same case, the present invention makes it possible to continue making communication in multi-code CDMA between a mobile station and a base station through channels of other base station(s).

It is preferable that the one of the base stations stops multi-code communication made with a mobile station only in a part of codes, when the one of the base stations receives a request of starting communication from another mobile station and judges that channels is short for satisfying the request, and transmits a request to the host station to make communication with other base station(s) in codes equal to the stopped codes, the host station, on receipt of the request to make communication with other base station(s), instructs a base station other than the one of the base stations to start making communication with the one of the base stations in codes equal to the stopped codes, and the mobile station stops communication made with the one of the base stations in the part of codes, and starts making communication with the base station other than the one of the base stations in codes equal to the stopped codes.

In the cellular system in accordance with the present invention, if channels of a base station are saturated while a mobile station is making multi-code CDMA communication with the base station, communication between the mobile station and the base station is partially stopped. A part of the stopped communication is made through the mobile station and other base station(s). Thus, the mobile station can continue making communication in multi-code CDMA with the base station through channels of other base station(s), for instance, a base station located adjacent to the base station.

If channels of a base station with which a mobile station is making communication in multi-code CDMA are saturated, it was impossible in the conventional cellular system to continue making communication in multi-code CDMA in a mobile station and a base station. In contrast, even in the same case,
5 the present invention makes it possible to continue making communication in multi-code CDMA between a mobile station and a base station through channels of other base station(s).

It is preferable that the one of the base stations and the other base station(s) have an adaptive array antenna.

10 Since an adaptive array antenna has high directivity, even if a mobile station is located in an area where channels of the above-mentioned other base station(s) generally cannot be assigned to a mobile station, it would be possible to assign channels to the mobile station.

The present invention further provides a method of making
15 communication in multi-code CDMA where a mobile station makes communication with base stations in multi-code CDMA and an host station controls communication made between the base stations and the mobile station, characterized by the step of, the mobile station, when one of the base stations becomes saturated, making communication in multi-code CDMA through a
20 channel of other base station(s).

The method provides the same advantages as those provided by the cellular system defined in claim 1.

It is preferable that the mobile station, when channels of a base station with which the mobile station makes communication are saturated, stops a part of
25 the communication, and makes the thus stopped part of the communication with other base station(s).

The method provides the same advantages as those provided by the cellular system defined in claim 2.

It is preferable that the one of the base station(s) and the other base

station(s) make communication with the mobile station in multi-code CDMA through an adaptive array antenna.

The present invention further provides a method of making communication in multi-code CDMA where a mobile station makes communication with base stations in multi-code CDMA and an host station controls communication made between the base stations and the mobile station, characterized by the steps of one of the base stations, on receipt of a request of starting communication in n codes (n is an integer equal to or greater than 2) from the mobile station, checking whether channels are short, and transmitting the result of checking to the host station, the host station receiving the result from the one of the base stations, and, if channels for n codes can be secured, instructing the one of the base stations to start making communication, whereas if channels for m codes (m is an integer smaller than n ($m < n$)) can be secured, instructing the one of the base stations to start making communication in m codes and further instructing other base station(s) to start making communication in $(n - m)$ codes, and the mobile station making communication with the one of the base stations in m codes, and further making communication with the other base station(s) in $(n - m)$ codes.

The method provides the same advantages as those provided by the cellular system defined in claim 4.

It is preferable that the method further includes the steps of the one of the base stations stopping multi-code communication made with a mobile station only in a part of codes, when the one of the base stations receives a request of starting communication from another mobile station and judges that channels is short for satisfying the request, and transmitting a request to the host station to make communication with other base station(s) in codes equal to the stopped codes, the host station, on receipt of the request to make communication with other base station(s), instructing a base station other than the one of the base stations to start making communication with the one of the base stations in codes

equal to the stopped codes, and the mobile station stopping communication made with the one of the base stations in the part of codes, and starting making communication with the base station other than the one of the base stations in codes equal to the stopped codes.

5 The method provides the same advantages as those provided by the cellular system defined in claim 5.

It is preferable that the one of the base station(s) and the other base station(s) make communication with the mobile station in multi-code CDMA through an adaptive array antenna.

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BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of the cellular system operating in multi-code CDMA, in accordance with a preferred embodiment of the present invention.

FIG. 2 is a flow chart showing the steps to be carried out by the cellular
15 system illustrated in FIG. 1.

FIG. 3 illustrates the cellular system operating in multi-code CDMA, in accordance with another embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

20 Preferred embodiments in accordance with the present invention will be explained hereinbelow with reference to drawings.

FIG. 1 is a block diagram of the cellular system operating in multi-code CDMA, in accordance with a preferred embodiment of the present invention.

25 The cellular system in accordance with the embodiment is comprised of a first base station 2a, a second base station 2b, a mobile station 3 making multi-code CDMA communication with the first and second base stations 2a and 2b, and an host station 1 controlling communication made between the first and second base stations 2a, 2b, and the mobile station 3.

Though FIG. 1 illustrates two base stations and one mobile station for

the purpose of simplification of explanation, the cellular system in accordance with the embodiment may be designed to include three or more base stations and two or more mobile stations.

The host station 1 is comprised of signal multiplexers 13a and 13b each of which multiplexes a voice signal (high-rate data signal) and a control signal to each other, and transmits the thus formed multiplexed signal to the first and second base stations 2a and 2b, respectively, signal demultiplexers 14a and 14b each of which demultiplexes a voice signal (high-rate data signal) and a control signal both transmitted from the first and second base stations 2a and 2b, from each other, a voice signal decoder 11 which is electrically connected to the signal demultiplexers 14a and 14b, and decodes a voice signal transmitted from the signal demultiplexers 14a and 14b, and a channel administrator 12 which is electrically connected to the voice signal decoder 11, the signal multiplexers 13a and 13b and the signal demultiplexers 14a and 14b, and assigns a channel to the first and second base stations 2a and 2b in accordance with a channel signal transmitted from the signal demultiplexers 14a and 14b.

The first base station 2a is comprised of a plurality of channel controllers 20a-1 to 20a-n (only the channel controller 20a-1 is illustrated in FIG. 1), a transmitter 27a which modulates signals to be transmitted from the channel controllers 20a-1 to 20a-n, a receiver 28a which demodulates signals having been transmitted from the mobile station 3, and an antenna 29a.

Each of the channel controllers 20a-1 to 20a-n is comprised of a signal demultiplexer 21a which demultiplexes a signal transmitted from the host station 1, into a voice signal (high-rate data signal) and a control signal, a descending diffusion code producer 23a which produces a descending diffusion code in accordance with the control signal transmitted from the signal demultiplexer 21a, an ascending diffusion code producer 24a which produces an ascending diffusion code in accordance with the control signal transmitted from the signal demultiplexer 21a, a diffuser 25a which diffuses and modulates the voice signal

transmitted from the signal demultiplexer 21a, based on the descending diffusion code transmitted from the descending diffusion code producer 23a, a reverse-diffuser 26a which reverse-diffuses and modulates a signal transmitted from the receiver 28a, based on the ascending diffusion code transmitted from the ascending diffusion code producer 24a, and a signal multiplexer 22a which multiplexes a voice signal (high-rate data signal) and a control signal to each other, and transmits the thus multiplexed signal to the host station 1.

The second base station 2b has the same structure as the structure of the first base station 2a.

The mobile station 3 has a conventional structure, and is designed to be able to make multi-code CDMA communication with the first and second base stations 2a and 2b.

For instance, when the mobile station 3 requests the first base station 2a to make high-rate communication in n (n is an integer equal to or greater than 2) diffusion codes in an area covered by the first base station 2a, communication in n diffusion codes is generally made between the first base station 2a and the mobile station 3.

Herein, it is assumed that it is impossible to secure channels for n diffusion codes, for instance, like a case where a lot of users have already made communication through the first base station 2a. In such a case, multi-code CDMA communication is made between the mobile station and the base station as follows in the cellular system in accordance with the embodiment.

Hereinbelow, explanation is made with reference to the flow chart illustrated in FIG. 2.

When the mobile station 3 makes a request to make high-rate communication in n diffusion codes in an area covered by the first base station 2a, in step ST1, the host station 1 asks the first base station 2a whether channels for n diffusion codes can be secured, in step ST2.

If channels for n diffusion codes can be secured (NO in step ST2), the

host station 1 instructs the first base station 2a to start making communication in n diffusion codes, in step ST10. On receipt of the instruction, the first base station 2a transmits a communication start signal to the mobile station 3, in step ST11, and thus, communication starts between the first base station 2a and the mobile station 3, in step ST12.

If channels for n diffusion codes cannot be secured (YES in step ST2), for instance, if channels only for m ($m < n$) diffusion codes can be secured, the host station 1 asks the second base station 2b whether channels for $(n-m)$ codes, which could not be secured by the first base station 2a, can be secured, in step ST3.

10 If the second base station 2b cannot secure channels for (n-m) codes
(YES in step ST3), the second base station 2b transmits a rejection signal to the
mobile station 3, in step ST4.

In contrast, if the second base station 2b can secure channels for $(n-m)$ codes (NO in step ST3), which could not be secured by the first base station 2a, the host station 1 instructs the first base station 2a to start making communication in m diffusion codes, in step ST5.

In addition, the host station 1 instructs the second base station 2b to start making communication in (n-m) diffusion codes, in step ST6.

On receipt of these instructions, the first base station 2a transmits a
 20 communication start signal to the mobile station 3, in step ST7, and the second
 base station 2b transmits a communication start signal to the mobile station 3, in
 step ST8. Then, communication starts between the mobile station and the first
 and second base stations 2a and 2b in assigned codes, respectively, in step ST9.

In accordance with the above-mentioned cellular system, even if the first base station 2a could not secure channels for n diffusion codes, communication can be made between the mobile station 3 and the first and second base stations 2a and 2b through channels for n codes, by using vacant channels of the second base station 2b.

In addition, it is possible to effectively use channels of base stations

Thus, even if the base station 2a could not secure channel for n codes during communication with the mobile station 3, it would be possible for the mobile station 3 to make communication with the first and second base stations 2a and 2b through channels for totally n codes, by using vacant channels of the second base station 2b.

In addition, it is possible to effectively use channels of base stations constituting the cellular system.

FIG. 3 illustrates the cellular system in accordance with another embodiment.

In comparison with the cellular system illustrated in FIG. 1, the cellular system in accordance with the present embodiment is different only in the antenna 29a of the first base station 2a and the antenna 29b of the second base station 2b, and is identical in structure to the cellular system illustrated in FIG. 1 except the antennas.

Specifically, each of the first and second base stations 2a and 2b in the present embodiment is designed to include an adaptive array antenna 30a and 30b as the antenna 29a and 29b, respectively.

Since the adaptive array antennas 30a and 30b have high directivity, it would be possible for the mobile station 3 located in an area covered by the first base station 2a to be less interfered with by the second base station 2b. Hence, even if the mobile station 3 is located in an area to which the second base station 2b cannot assign a channel, as illustrated in FIG. 3, it would be possible to assign a channel to the mobile station 3 through the adaptive antenna 30b.

INDUSTRIAL APPLICABILITY

As having been explained so far, the cellular system and the method of making communication both in accordance with the present invention provide the following advantages.

The first advantage is that even if channels of a certain base station are

saturated, it would be possible to make communication with the base station through channels of other base station(s). Accordingly, it would be possible to enhance an efficiency at which channels of a base station(s) are used, in multi-code CDMA communication.

5 The second advantage is that the number and/or volume of units for controlling channels of a base station can be reduced in dependence on channels of adjacent base stations. Hence, it would be possible to construct a base station in a smaller size in multi-code CDMA communication. Accordingly, the present invention can be applied to a cellular system such as a cellular system using pico-
10 cells.

CELLULAR SYSTEM
AND
METHOD OF MAKING COMMUNICATION IN MULTI-CODE CDMA

5 BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The invention relates to a cellular system and a method of making communication in multi-code CDMA both of which are capable of effectively using channels of a base station or base stations in multi-code CDMA (Code Division
10 Multiple Access) communication.

DESCRIPTION OF THE RELATED ART

There have been suggested many mobile communication apparatuses or systems operating in CDMA. For instance, Japanese Unexamined Patent
15 Publication No. 8-274687 has suggested a CDMA wireless communication system, Japanese Unexamined Patent Publication No. 9-200115 has suggested a method of controlling directivity of an antenna in a radio-station in CDMA wireless communication system, Japanese Unexamined Patent Publication No. 10-190626 has suggested a CDMA receiver, Japanese Unexamined Patent Publication No.
20 10-308972 has suggested a CDMA cellular system, and Japanese Unexamined Patent Publication No. 11-74820 has suggested a CDMA signal receiver.

When a mobile communication system operating in CDMA transmits data at a rate greater than a data transmission rate per one channel (one diffusion sign), it generally transmits data in multi-code transmission where it
25 assigns a plurality of channels, that is, a plurality of diffusion signs to a user, and transmits data through a plurality of channels.

However, a conventional mobile communication system operating in multi-code CDMA is accompanied with the following two problems.

The first problem is that when high-rate communication is to be made

in multi-code, if it is not possible to secure channels of a base station for all codes, the system cannot provide services to a mobile station.

The second problem is that when high-rate communication is to be made in multi-code, it would be necessary to increase the number of channels in a base station in order to provide a high connection ratio to a mobile station, resulting in that a base station could not be constructed in a small size.

SUMMARY OF THE INVENTION

In order to solve the above-mentioned problems in the conventional mobile communication system operating in multi-code CDMA, it is an object of the present invention to provide a cellular system operating in multi-code CDMA and a method of making communication in multi-code CDMA both of which are capable of effectively using channels of a base station, when high-rate communication is to be made in multi-code CDMA.

In one aspect of the present invention, there is provided a cellular system including at least two base stations, a mobile station making communication with the base stations in multi-code CDMA, and an host station controlling communication made between the base stations and the mobile station, wherein the mobile station, when channels of a base station with which the mobile station makes multi-code CDMA communication are saturated, stops a part of the communication, and makes the thus stopped part of the communication with other base station(s).

In the cellular system in accordance with the present invention, if channels of a base station are saturated while a mobile station is making multi-code CDMA communication with the base station, communication between the mobile station and the base station is partially stopped. A part of the stopped communication is made through the mobile station and other base station(s). Thus, the mobile station can continue making communication in multi-code CDMA with the base station through channels of other base station(s), for

instance, a base station located adjacent to the base station.

If channels of a base station with which a mobile station is making communication in multi-code CDMA are saturated, it was impossible in the conventional cellular system to continue making communication in multi-code
 5 CDMA in a mobile station and a base station. In contrast, even in the same case, the present invention makes it possible to continue making communication in multi-code CDMA between a mobile station and a base station through channels of other base station(s).

It is preferable that the one of the base station(s) and the other base
 10 station(s) have an adaptive array antenna.

Since an adaptive array antenna has high directivity, even if a mobile station is located in an area where channels of the above-mentioned other base station(s) generally cannot be assigned to a mobile station, it would be possible to assign channels to the mobile station.

There is further provided a cellular system including at least two base
 15 stations, a mobile station making communication with the base stations in multi-code CDMA, and an host station controlling communication made between the base stations and the mobile station, wherein one of the base stations, on receipt of a request of starting communication in n codes (n is an integer equal to or
 20 greater than 2) from the mobile station, checks whether channels are short, and transmits the result of checking to the host station, the host station receives the result from the one of the base stations, and, if channels for n codes can be secured, instructs the one of the base stations to start making communication, whereas if
 channels for m codes (m is an integer smaller than n ($m < n$)) can be secured,
 25 instructs the one of the base stations to start making communication in m codes and further instructs other base station(s) to start making communication in $(n - m)$ codes, and the mobile station makes communication with the one of the base stations in m codes, and further makes communication with the other base station(s) in $(n - m)$ codes.

In the cellular system in accordance with the present invention, a base station, on receipt of a request to start making communication in n codes, judges whether it is possible to secure channels covering n codes. If possible, the base station makes communication in n codes with a mobile station. If not possible,
5 the base station counts the number of codes the base station can secure. For instance, if the base station can secure m codes, the mobile station makes communication in m codes with the base station, and further makes communication in $(n - m)$ codes with other base station(s). That is, the mobile station makes communication with two base stations in totally n codes.

10 In the cellular system in accordance with the present invention, even if channels of a base station are saturated while a mobile station is making multi-code CDMA communication with the base station, the mobile station can continue making communication in multi-code CDMA with the base station through channels of other base station(s), for instance, a base station located adjacent to
15 the base station.

If channels of a base station with which a mobile station is making communication in multi-code CDMA are saturated, it was impossible in the conventional cellular system to continue making communication in multi-code CDMA in a mobile station and a base station. In contrast, even in the same case,
20 the present invention makes it possible to continue making communication in multi-code CDMA between a mobile station and a base station through channels of other base station(s).

It is preferable that the one of the base stations stops multi-code communication made with a mobile station only in a part of codes, when the one of
25 the base stations receives a request of starting communication from another mobile station and judges that channels is short for satisfying the request, and transmits a request to the host station to make communication with other base station(s) in codes equal to the stopped codes, the host station, on receipt of the request to make communication with other base station(s), instructs a base

station other than the one of the base stations to start making communication with the one of the base stations in codes equal to the stopped codes, and the mobile station stops communication made with the one of the base stations in the part of codes, and starts making communication with the base station other than
5 the one of the base stations in codes equal to the stopped codes.

In the cellular system in accordance with the present invention, if channels of a base station are saturated while a mobile station is making multi-code CDMA communication with the base station, communication between the mobile station and the base station is partially stopped. A part of the stopped communication is made through the mobile station and other base station(s). Thus, the mobile station can continue making communication in multi-code CDMA with the base station through channels of other base station(s), for instance, a base station located adjacent to the base station.

If channels of a base station with which a mobile station is making communication in multi-code CDMA are saturated, it was impossible in the conventional cellular system to continue making communication in multi-code CDMA in a mobile station and a base station. In contrast, even in the same case, the present invention makes it possible to continue making communication in multi-code CDMA between a mobile station and a base station through channels of other base station(s).

It is preferable that the one of the base stations and the other base station(s) have an adaptive array antenna.

Since an adaptive array antenna has high directivity, even if a mobile station is located in an area where channels of the above-mentioned other base station(s) generally cannot be assigned to a mobile station, it would be possible to assign channels to the mobile station.

In another aspect of the present invention, there is provided a method of making communication in multi-code CDMA where a mobile station makes communication with base stations in multi-code CDMA and an host station

controls communication made between the base stations and the mobile station,

the method comprising the steps of stopping a part of multi-code CDMA communication when channels of a base station with which the mobile station makes the multi-code CDMA communication are saturated, and making the thus
5 stopped part of the multi-code CDMA communication through a channel of other base station(s).

It is preferable that the one of the base station(s) and the other base station(s) make communication with the mobile station in multi-code CDMA through an adaptive array antenna.

There is further provided a method of making communication in multi-code CDMA where a mobile station makes communication with base stations in multi-code CDMA and an host station controls communication made between the base stations and the mobile station, characterized by the steps of one of the base stations, on receipt of a request of starting communication in n codes (n is an
15 integer equal to or greater than 2) from the mobile station, checking whether channels are short, and transmitting the result of checking to the host station, the host station receiving the result from the one of the base stations, and, if channels for n codes can be secured, instructing the one of the base stations to start making communication, whereas if channels for m codes (m is an integer smaller than n
20 ($m < n$)) can be secured, instructing the one of the base stations to start making communication in m codes and further instructing other base station(s) to start making communication in $(n - m)$ codes, and the mobile station making communication with the one of the base stations in m codes, and further making communication with the other base station(s) in $(n - m)$ codes.

It is preferable that the method further includes the steps of the one of the base stations stopping multi-code communication made with a mobile station only in a part of codes, when the one of the base stations receives a request of starting communication from another mobile station and judges that channels is short for satisfying the request, and transmitting a request to the host station to

make communication with other base station(s) in codes equal to the stopped codes, the host station, on receipt of the request to make communication with other base station(s), instructing a base station other than the one of the base stations to start making communication with the one of the base stations in codes
5 equal to the stopped codes, and the mobile station stopping communication made with the one of the base stations in the part of codes, and starting making communication with the base station other than the one of the base stations in codes equal to the stopped codes.

It is preferable that the one of the base station(s) and the other base
10 station(s) make communication with the mobile station in multi-code CDMA through an adaptive array antenna.

The advantages obtained by the aforementioned present invention will be described hereinbelow.

As having been explained so far, the cellular system and the method of
15 making communication both in accordance with the present invention provide the following advantages.

The first advantage is that even if channels of a certain base station are saturated, it would be possible to make communication with the base station through channels of other base station(s). Accordingly, it would be possible to
20 enhance an efficiency at which channels of a base station(s) are used, in multi-code CDMA communication.

The second advantage is that the number and/or volume of units for controlling channels of a base station can be reduced in dependence on channels of adjacent base stations. Hence, it would be possible to construct a base station in
25 a smaller size in multi-code CDMA communication. Accordingly, the present invention can be applied to a cellular system such as a cellular system using pico-cells.

The above and other objects and advantageous features of the present invention will be made apparent from the following description made with

reference to the accompanying drawings, in which like reference characters designate the same or similar parts throughout the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

5 FIG. 1 is a block diagram of the cellular system operating in multi-code CDMA, in accordance with a preferred embodiment of the present invention.

 FIG. 2 is a flow chart showing the steps to be carried out by the cellular system illustrated in FIG. 1.

10 FIG. 3 illustrates the cellular system operating in multi-code CDMA, in accordance with another embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

 Preferred embodiments in accordance with the present invention will be explained hereinbelow with reference to drawings.

15 FIG. 1 is a block diagram of the cellular system operating in multi-code CDMA, in accordance with a preferred embodiment of the present invention.

 The cellular system in accordance with the embodiment is comprised of a first base station 2a, a second base station 2b, a mobile station 3 making multi-code CDMA communication with the first and second base stations 2a and 2b, and
20 an host station 1 controlling communication made between the first and second base stations 2a, 2b, and the mobile station 3.

 Though FIG. 1 illustrates two base stations and one mobile station for the purpose of simplification of explanation, the cellular system in accordance with the embodiment may be designed to include three or more base stations and
25 two or more mobile stations.

 The host station 1 is comprised of signal multiplexers 13a and 13b each of which multiplexes a voice signal (high-rate data signal) and a control signal to each other, and transmits the thus formed multiplexed signal to the first and second base stations 2a and 2b, respectively, signal demultiplexers 14a and 14b

each of which demultiplexes a voice signal (high-rate data signal) and a control signal both transmitted from the first and second base stations 2a and 2b, from each other, a voice signal decoder 11 which is electrically connected to the signal demultiplexers 14a and 14b, and decodes a voice signal transmitted from the signal demultiplexers 14a and 14b, and a channel administrator 12 which is electrically connected to the voice signal decoder 11, the signal multiplexers 13a and 13b and the signal demultiplexers 14a and 14b, and assigns a channel to the first and second base stations 2a and 2b in accordance with a channel signal transmitted from the signal demultiplexers 14a and 14b.

The first base station 2a is comprised of a plurality of channel controllers 20a-1 to 20a-n (only the channel controller 20a-1 is illustrated in FIG. 1), a transmitter 27a which modulates signals to be transmitted from the channel controllers 20a-1 to 20a-n, a receiver 28a which demodulates signals having been transmitted from the mobile station 3, and an antenna 29a.

Each of the channel controllers 20a-1 to 20a-n is comprised of a signal demultiplexer 21a which demultiplexes a signal transmitted from the host station 1, into a voice signal (high-rate data signal) and a control signal, a descending diffusion code producer 23a which produces a descending diffusion code in accordance with the control signal transmitted from the signal demultiplexer 21a, an ascending diffusion code producer 24a which produces an ascending diffusion code in accordance with the control signal transmitted from the signal demultiplexer 21a, a diffuser 25a which diffuses and modulates the voice signal transmitted from the signal demultiplexer 21a, based on the descending diffusion code transmitted from the descending diffusion code producer 23a, a reverse-diffuser 26a which reverse-diffuses and modulates a signal transmitted from the receiver 28a, based on the ascending diffusion code transmitted from the ascending diffusion code producer 24a, and a signal multiplexer 22a which multiplexes a voice signal (high-rate data signal) and a control signal to each other, and transmits the thus multiplexed signal to the host station 1.

The second base station 2b has the same structure as the structure of the first base station 2a.

The mobile station 3 has a conventional structure, and is designed to be able to make multi-code CDMA communication with the first and second base stations 2a and 2b.

For instance, when the mobile station 3 requests the first base station 2a to make high-rate communication in n (n is an integer equal to or greater than 2) diffusion codes in an area covered by the first base station 2a, communication in n diffusion codes is generally made between the first base station 2a and the mobile station 3.

Herein, it is assumed that it is impossible to secure channels for n diffusion codes, for instance, like a case where a lot of users have already made communication through the first base station 2a. In such a case, multi-code CDMA communication is made between the mobile station and the base station as follows in the cellular system in accordance with the embodiment.

Hereinbelow, explanation is made with reference to the flow chart illustrated in FIG. 2.

When the mobile station 3 makes a request to make high-rate communication in n diffusion codes in an area covered by the first base station 2a, in step ST1, the host station 1 asks the first base station 2a whether channels for n diffusion codes can be secured, in step ST2.

If channels for n diffusion codes can be secured (NO in step ST2), the host station 1 instructs the first base station 2a to start making communication in n diffusion codes, in step ST10. On receipt of the instruction, the first base station 2a transmits a communication start signal to the mobile station 3, in step ST11, and thus, communication starts between the first base station 2a and the mobile station 3, in step ST12.

If channels for n diffusion codes cannot be secured (YES in step ST2), for instance, if channels only for m ($m < n$) diffusion codes can be secured, the host

station 1 asks the second base station 2b whether channels for $(n-m)$ codes, which could not be secured by the first base station 2a, can be secured, in step ST3.

If the second base station 2b cannot secure channels for $(n-m)$ codes (YES in step ST3), the second base station 2b transmits a rejection signal to the
5 mobile station 3, in step ST4.

In contrast, if the second base station 2b can secure channels for $(n-m)$ codes (NO in step ST3), which could not be secured by the first base station 2a, the host station 1 instructs the first base station 2a to start making communication in m diffusion codes, in step ST5.

10 In addition, the host station 1 instructs the second base station 2b to start making communication in $(n-m)$ diffusion codes, in step ST6.

On receipt of these instructions, the first base station 2a transmits a communication start signal to the mobile station 3, in step ST7, and the second base station 2b transmits a communication start signal to the mobile station 3, in
15 step ST8. Then, communication starts between the mobile station and the first and second base stations 2a and 2b in assigned codes, respectively, in step ST9.

In accordance with the above-mentioned cellular system, even if the first base station 2a could not secure channels for n diffusion codes, communication can be made between the mobile station 3 and the first and second
20 base stations 2a and 2b through channels for n codes, by using vacant channels of the second base station 2b.

In addition, it is possible to effectively use channels of base stations constituting the cellular system.

In the above-mentioned embodiment, it was assumed that the first base
25 station 2a could not secure channels for n diffusion codes at the beginning of communication. However, though the first base station 2a could once secure channels for n codes, the first base station 2a becomes short of channels during communication. Even in such a case, as mentioned below, it is possible for the mobile station 3 to make communication with the first and second base stations

2a and 2b through channels for n diffusion codes, by using vacant channels of the second base station 2b.

Herein, for instance, it is assumed that while the first base station 2a is making multi-code CDMA communication with the mobile station 3, the first base station 2a receives a request to make communication, from another mobile station, resulting in shortage in channels.

The first base station 2a stops multi-code CDMA communication in some codes, and requests the host station 1 to change a base station in order to make communication with the second base station 2b in codes corresponding to the stopped codes.

On receipt of the request from the first base station 2a, the host station 1 instructs the second base station 2b located adjacent to the first base station 2b, to start making communication in codes corresponding to the stopped codes. As a result, the mobile station 3 stops making multi-code CDMA communication with the first base station 2a in some codes, and starts making communication with the second base station 2b in codes corresponding to the stopped codes.

As mentioned above, if the number of mobile stations with which the first base station 2a makes communication is increased, and resultingly, channels of the first base station 2a are saturated, the mobile station 3 making multi-code CDMA communication with the first base station 2a stops making communication in some codes with the first base station 2a, and starts making communication with the second base station in codes corresponding to the stopped codes.

Thus, even if the base station 2a could not secure channel for n codes during communication with the mobile station 3, it would be possible for the mobile station 3 to make communication with the first and second base stations 2a and 2b through channels for totally n codes, by using vacant channels of the second base station 2b.

In addition, it is possible to effectively use channels of base stations constituting the cellular system.

FIG. 3 illustrates the cellular system in accordance with another embodiment.

In comparison with the cellular system illustrated in FIG. 1, the cellular system in accordance with the present embodiment is different only in the antenna 29a of the first base station 2a and the antenna 29b of the second base station 2b, and is identical in structure to the cellular system illustrated in FIG. 1 except the antennas.

Specifically, each of the first and second base stations 2a and 2b in the present embodiment is designed to include an adaptive array antenna 30a and 30b as the antenna 29a and 29b, respectively.

Since the adaptive array antennas 30a and 30b have high directivity, it would be possible for the mobile station 3 located in an area covered by the first base station 2a to be less interfered with by the second base station 2b. Hence, even if the mobile station 3 is located in an area to which the second base station 2b cannot assign a channel, as illustrated in FIG. 3, it would be possible to assign a channel to the mobile station 3 through the adaptive antenna 30b.

While the present invention has been described in connection with certain preferred embodiments, it is to be understood that the subject matter encompassed by way of the present invention is not to be limited to those specific 20 embodiments. On the contrary, it is intended for the subject matter of the invention to include all alternatives, modifications and equivalents as can be included within the spirit and scope of the following claims.

ART 34 AMDT

10031344-051002

10/031344

53: RECEIVED 18 JAN 2002

**Translation of the Amendment filed to the International Bureau
under Act 34 of Patent Cooperation Treaty (PCT)**

- 5 Please amend claims as follows.
1. Claim 1 at page 12 is canceled.
 2. Claim 2 at page 12 is rewritten into an independent form as a result of
cancellation of claim 1.
 3. Claim 3 at page 12 is canceled.
 - 10 4. Claim 7 at page 13 is canceled.
 5. Claim 8 at page 13 is rewritten into an independent form as a result of
cancellation of claim 7.
 6. Claim 9 at pages 12-13 is canceled.

15

Claims after Amended

1. Canceled.
- 20 2. (Amended) A cellular system including:
at least two base stations;
a mobile station making communication with said base stations in multi-
code CDMA; and
25 an host station controlling communication made between said base stations
and said mobile station,
characterized in that when one of said base stations becomes saturated, said
mobile station makes communication in multi-code CDMA through a channel of
other base station(s), and

said mobile station, when channels of a base station with which said mobile station makes communication are saturated, stops a part of said communication, and makes the thus stopped part of said communication with other base station(s).

5

3. Canceled.

4. A cellular system including:

at least two base stations;

10 a mobile station making communication with said base stations in multi-code CDMA; and

an host station controlling communication made between said base stations and said mobile station,

characterized in that

15 one of said base stations, on receipt of a request of starting communication in n codes (n is an integer equal to or greater than 2) from said mobile station, checks whether channels are short, and transmits the result of checking to said host station,

said host station receives said result from said one of said base stations, and,
20 if channels for n codes can be secured, instructs said one of said base stations to start making communication, whereas if channels for m codes (m is an integer smaller than n ($m < n$)) can be secured, instructs said one of said base stations to start making communication in m codes and further instructs other base station(s) to start making communication in $(n - m)$ codes, and

25 said mobile station makes communication with said one of said base stations in m codes, and further makes communication with said other base station(s) in $(n - m)$ codes.

5. The cellular system as set forth in claim 1, wherein said one of said base

stations stops multi-code communication made with a mobile station only in a part of codes, when said one of said base stations receives a request of starting communication from another mobile station and judges that channels is short for satisfying said request, and transmits a request to said host station to make
5 communication with other base station(s) in codes equal to the stopped codes,

said host station, on receipt of said request to make communication with other base station(s), instructs a base station other than said one of said base stations to start making communication with said one of said base stations in codes equal to said stopped codes, and

10 said mobile station stops communication made with said one of said base stations in said part of codes, and starts making communication with said base station other than said one of said base stations in codes equal to said stopped codes.

15 6. The cellular system as set forth in claim 4 or 5, wherein said one of said base stations and said other base station(s) have an adaptive array antenna.

7. Canceled.

20 8. (Amended) A method of making communication in multi-code CDMA where a mobile station makes communication with base stations in multi-code CDMA and an host station controls communication made between said base stations and said mobile station,

characterized by the step of, said mobile station, when one of said base
25 stations becomes saturated, making communication in multi-code CDMA through a channel of other base station(s),

wherein said mobile station, when channels of a base station with which said mobile station makes communication are saturated, stops a part of said communication, and makes the thus stopped part of said communication with

other base station(s).

9. Canceled.

5 10. A method of making communication in multi-code CDMA where a mobile station makes communication with base stations in multi-code CDMA and an host station controls communication made between said base stations and said mobile station,

characterized by the steps of:

10 one of said base stations, on receipt of a request of starting communication in n codes (n is an integer equal to or greater than 2) from said mobile station, checking whether channels are short, and transmitting the result of checking to said host station,

 said host station receiving said result from said one of said base stations, and,
15 if channels for n codes can be secured, instructing said one of said base stations to start making communication, whereas if channels for m codes (m is an integer smaller than n ($m < n$)) can be secured, instructing said one of said base stations to start making communication in m codes and further instructing other base station(s) to start making communication in $(n - m)$ codes, and

20 said mobile station making communication with said one of said base stations in m codes, and further making communication with said other base station(s) in $(n - m)$ codes.

11. The method as set forth in claim 10, further comprising the steps of:

25 said one of said base stations stopping multi-code communication made with a mobile station only in a part of codes, when said one of said base stations receives a request of starting communication from another mobile station and judges that channels is short for satisfying said request, and transmitting a request to said host station to make communication with other base station(s) in

codes equal to the stopped codes;

said host station, on receipt of said request to make communication with other base station(s), instructing a base station other than said one of said base stations to start making communication with said one of said base stations in
5 codes equal to said stopped codes; and

said mobile station stopping communication made with said one of said base stations in said part of codes, and starting making communication with said base station other than said one of said base stations in codes equal to said stopped codes.

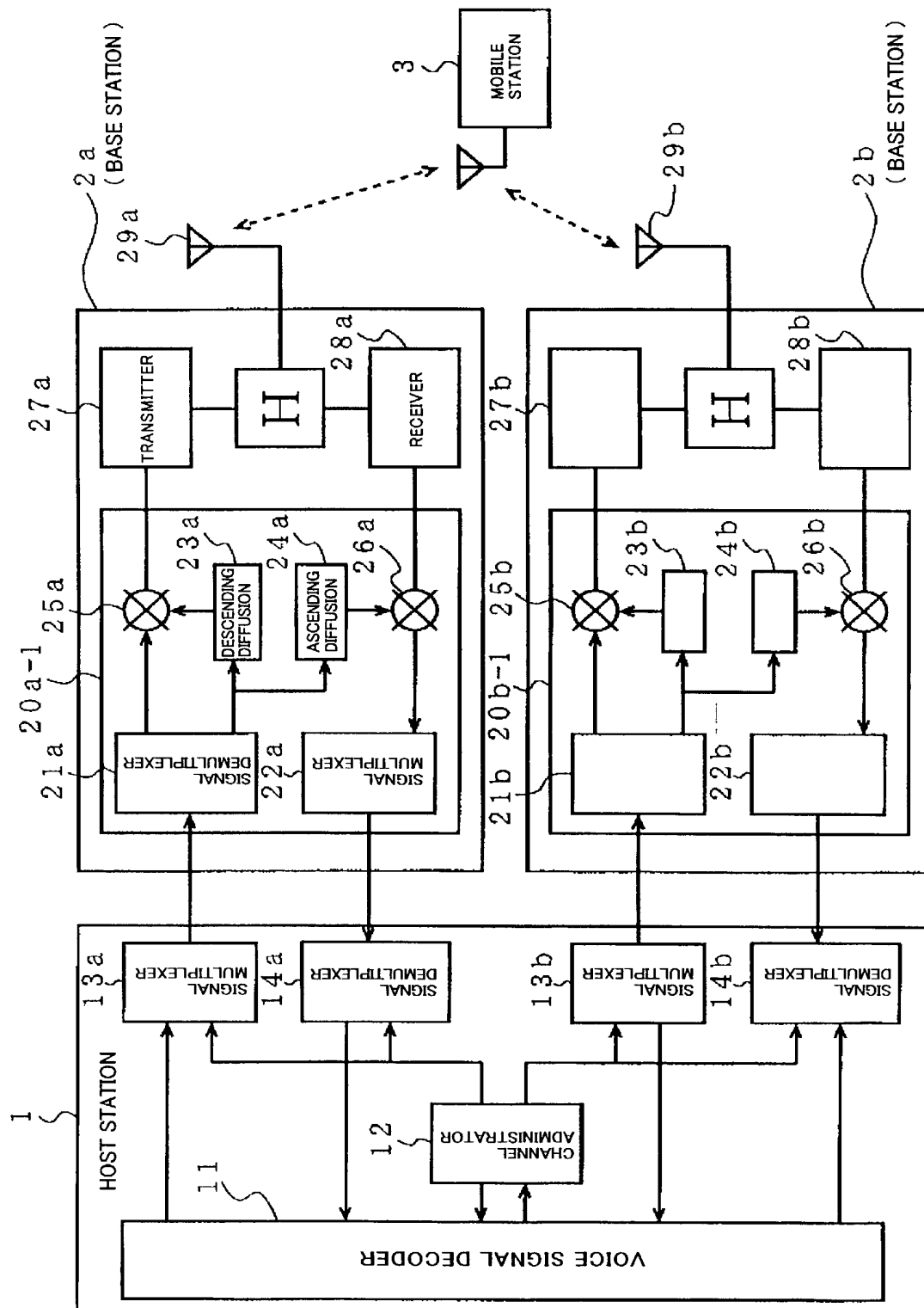
10

12. The method as set forth in claim 10 or 11, wherein said one of said base station(s) and said other base station(s) make communication with said mobile station in multi-code CDMA through an adaptive array antenna.

ABSTRACT OF THE DISCLOSURE

5 A cellular system in accordance with the present invention includes at least two base stations, a mobile station making communication with the base stations in multi-code CDMA, and an host station controlling communication made between the base stations and the mobile station. When one of the base stations becomes saturated, the mobile station makes communication in multi-code CDMA through a channel of other base station(s).

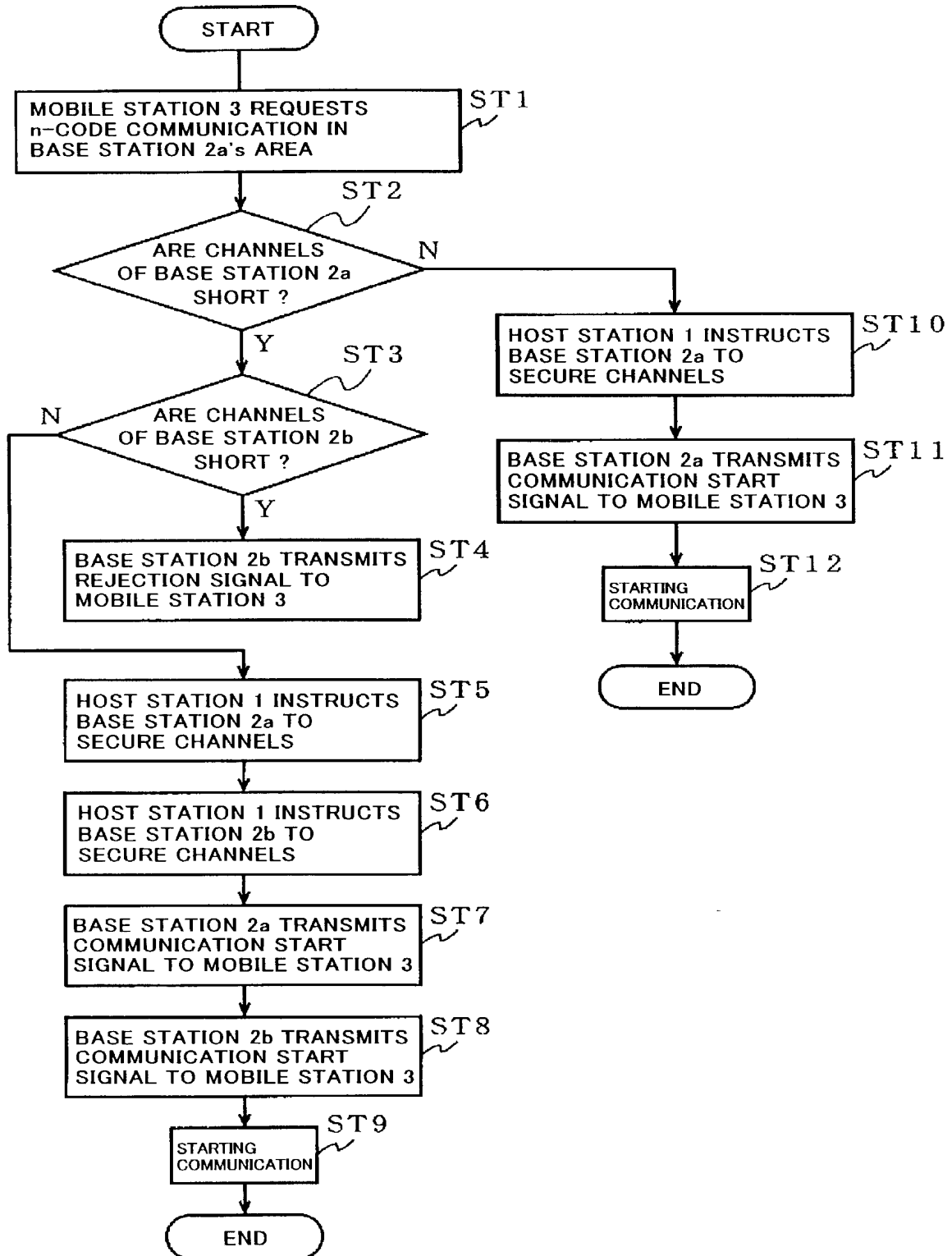
FIG.1



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2/3

FIG. 2



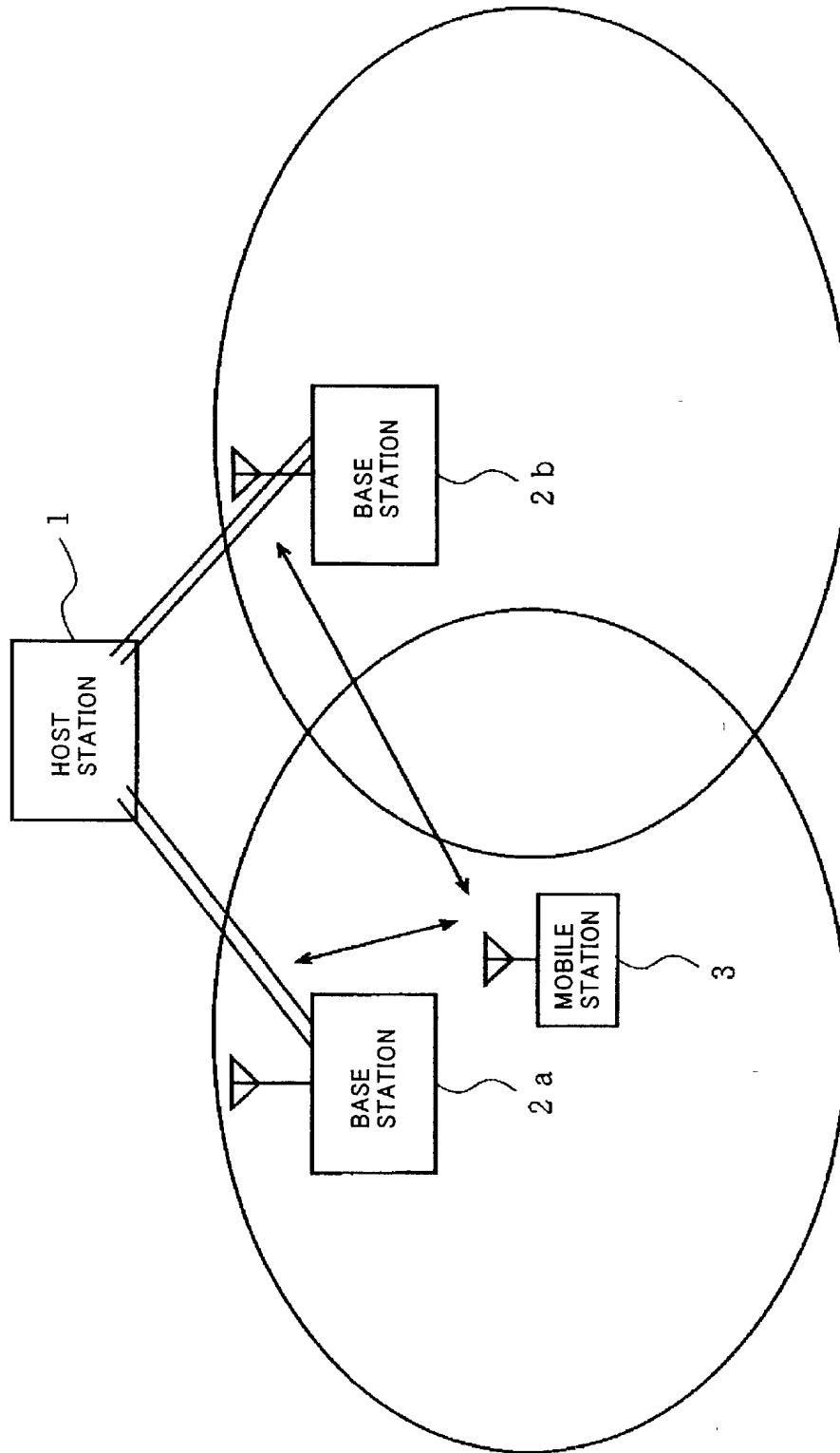
Title: CELLULAR SYSTEM AND
METHOD OF MAKING
COMMUNICATION IN MULTI-CODE
CDMA

Inventor(s): Yoshiki WAKIZAKA
Atty. Docket No.: 037267-0142

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10031344 10/031344

FIG.3



DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I HEREBY DECLARE:

THAT my residence, post office address, and citizenship are as stated below next to my name;

THAT I believe I am the original, first, and sole inventor (if only one inventor is named below) or an original, first, and joint inventor (if plural inventors are named below or in an attached Declaration) of the subject matter which is claimed and for which a patent is sought on the invention entitled

CELLULAR SYSTEM AND METHOD OF MAKING COMMUNICATION
IN MULTI-CODE CDMA

the specification of which (check one)

_____ is attached hereto.

_____ was filed on _____ as United States Application Number or PCT International Application Number _____ and was amended on _____ (if applicable).

THAT I do not know and do not believe that the same invention was ever known or used by others in the United States of America, or was patented or described in any printed publication in any country, before I (we) invented it;

THAT I do not know and do not believe that the same invention was patented or described in any printed publication in any country, or in public use or on sale in the United States of America, for more than one year prior to the filing date of this United States application;

THAT I do not know and do not believe that the same invention was first patented or made the subject of an inventor's certificate that issued in any country foreign to the United States of America before the filing date of this United States application if the foreign application was filed by me (us), or by my (our) legal representatives or assigns, more than twelve months (six months for design patents) prior to the filing date of this United States application;

THAT I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment specifically referred to above;

THAT I believe that the above-identified specification contains a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the invention, and sets forth the best mode contemplated by me of carrying out the invention; and

Atty. Dkt. No. _____

THAT I acknowledge the duty to disclose to the U.S. Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56.

I HEREBY CLAIM foreign priority benefits under Title 35, United States Code § 119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below any foreign application for patent or inventor's certificate or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number	Country	Foreign Filing Date	Priority Claimed?	Certified Copy Attached?
11-207272	Japan	July 22, 1999	Yes	

I HEREBY CLAIM the benefit under Title 35, United States Code § 119(e) of any United States provisional application(s) listed below.

U.S. Provisional Application Number	Filing Date

I HEREBY CLAIM the benefit under Title 35, United States Code, § 120 of any United States application(s), or § 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application Number	PCT Parent Application Number	Parent Filing Date	Parent Patent Number

Atty. Dkt. No. _____

I HEREBY APPOINT the following registered attorneys and agents of the law firm of FOLEY & LARDNER to have full power to prosecute this application and any continuations, divisions, reissues, and reexaminations thereof, to receive the patent, and to transact all business in the United States Patent and Trademark Office connected therewith:

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DAVID A. BLUMENTHAL	Reg. No. 26,257
BETH A. BURROUS	Reg. No. 35,087
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I UNDERSTAND AND AGREE THAT the foregoing attorneys and agents appointed by me to prosecute this application do not personally represent me or my legal interests, but instead represent the interests of the legal owner(s) of the invention described in this application.

I FURTHER DECLARE THAT all statements made herein of my own knowledge are true, and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Atty. Dkt. No. _____

1 - 00 Name of first inventor

Residence

Citizenship

Post Office Address

Inventor's signature

Date

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